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The West Shawano Upland of Wisconsin: A Study of Regional Development Basic to the Problem of Part of the Great Lakes Cut-Over Region

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INTRODUCTION

The geographer may occasionally have the good fortune to study an area which serves as a model for forecasting the future development of another region of similar environment. The first region, as a result of the sequence of its occupancy, the cultural forms which have evolved there, and the landscape which has developed under the imprint of man may well be the type of region into which the other or second area might develop. For good or bad, the first region should be described and interpreted; the results and forecasts may well serve as a "model" or as a "warning" for guidance of the development of the second region. Particularly are these forecasts and warnings of significance to the second area if the latter is developing upon sub-marginal land, in an environment none too hospitable for man's emergence to a dominant and secure position in the region. The land planner, state agencies, county boards, and other organizations concerned with problems of the second region may well take forewarning from the actual present condition of the first area. The geographer, if he has first-hand acquaintance with the areas through field studies, can be of aid to the planner and gov-

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ernmental administrators who must guide the development of the region of newer settlement in the light of the mistakes made and difficulties encountered in the evolution of the older. When man has an existing "laboratory experiment" before his very eyes, why should not he take advantage of its lessons in the same way that a scientist builds his future research plans upon previous laboratory experience? While some may say that human resources may differ regionally, such will not presumably be the case if the two regions are close together, environmentally similar, and settled by peoples of the same general racial stocks, backgrounds of similar experiences and education, but removed from one another only by the time factor since, obviously, one region has been settled for some time while the other is either about to be settled or is in process of settlement. Although labor and price factors will not be the same in the two different times of settlement, for the geographical purposes of regional comparison they have been eliminated. Presumably at any given time the prices received in the two generally adjacent regions would be nearly the same; the tax rates, however, might differ greatly.¹

THE REGIONS TO BE COMPARED

The West Shawano Upland of Wisconsin fits the requirements of the older, settled area, as outlined above. The whole of the non-sandy crystalline shield of northern Wisconsin is a region of the second or newer type.² The West Shawano Upland has been settled since the 1890's and 1900's. Northern Wisconsin, while having widely spaced farm communities, some of them dating from the 1890's, is still generally in the pre-settlement, early settlement or partial settlement stage of development. Some of northern Wisconsin never should have been developed agriculturally, much of it never will be, and large blocks of land are already closed to agricultural settlement through the operations of the Wisconsin zoning laws. Despite exigencies of the war, and of planning for the peace to come, it seems wise to take stock of an existing domestic situation, for who can foretell but that

¹ The writer recognizes that differing labor costs at different periods of time play a great part in the cost of land clearing. There is no question that some land cleared in far northern Wisconsin by foreign immigrants in the 1890's, using the labor of their large families, would probably never have been cleared in the late 1920's with the use of hired labor. Neither would the sons of the original immigrants have cleared, considering costs and returns, some of the land their fathers put under the plow a generation earlier.

² The three sandy regions of northern Wisconsin must be excluded from the comparison because of the non-similarity of their environment to that of the West Shawano Upland, largely the result of their local soils. For a map of the geographic regions of Wisconsin see the *Geographical Review*, Vol. XXIII, 1933, page 135. The three northern sandy regions are shown on the map as #3, The Northwestern Sand Region, #4, the Northern Lakes Country, and #5, the Northeastern Sand Region.

possible pressures may be exerted to vitiate existing zonal regulations, to throw more land open to settlement, as has been the case following past wars (even World War I was followed by an active settlement era and increase of land clearing in Northern Wisconsin), and to give returning soldiers an easier opportunity to obtain land. Certainly it is the writer's opinion that a study of the West Shawano Upland as a type region of what may be expected in Northern Wisconsin is both timely and pertinent. A regional laboratory of the type and age of the West Shawano Upland is not commonly found in juxtaposition to a larger undeveloped area having similar physical features, and is usually not found in such size and stage of development. Hence, following analysis (historical as well as geographic) of the West Shawano Upland, the writer proposes to use the results as a basis of forecast for the large Laurentian Upland area of the northern portion of Wisconsin.

Specific definition and delineation of the regions to be discussed and compared are necessary so that no misunderstanding will occur, particularly since the second region as outlined above does not include all of Northern Wisconsin. Some geographic regions of the north are unlike the West Shawano Upland in environment. It is only those areas which are environmentally similar that merit comparison, and only the latter areas to which forecasts and conclusions drawn from the existing experiences of the West Shawano Upland are applicable. (The northern sandy regions are specifically excluded.)

THE WEST SHAWANO UPLAND: LOCATION AND BOUNDARIES

The West Shawano Upland is one of twenty-two geographic regions of Wisconsin.³ It is located in the north-central portion of the state, overlying the crystalline rocks of the Northern Highland of Wisconsin, a part of the Laurentian Shield of North America. It is in the recently glaciated portion of the Northern Highland, and hence is developed upon young, stony glacial drift of Wisconsin age. It is the *one* fairly well settled and developed geographic region of the Northern Highland that occurs in a glaciated area mantled by young drift.⁴

³ *Ibid.*, page 135.

⁴ There are three well-settled geographic regions in north-central Wisconsin on the Northern Highland. The rest of the Highland is only sporadically settled. The Central Dairy Region lies on old drift, the only portion of the Northern Highland not covered by drift of the most recent, or Wisconsin age. The Antigo Flats is a gigantic outwash plain of Wisconsin age, caught in the interlobate angle between the Chippewa and Green Bay lobes of the Wisconsin glacier; its flat surface and special soils environment makes it unlike the true northern countryside. The West Shawano Upland is typically glaciated northern terrain, and, since it has been settled for so long, is a good laboratory for study of the larger area.

The West Shawano Upland has boundaries which are sharp in places, transitional in others; boundaries which are located along natural features and boundaries which are cultural in origin. The major man-made boundary is that of the north and northeast where the region ends abruptly against the artificial border of the Menominee Indian Reservation. Cultivated fields, stony pastures, farm woodlots all terminate against the nearly completely wooded Reservation, in some places against virgin timber, for the Indian Lands contain some of the largest remaining stands of such timber in the state. One of the major state highways, within a few yards, plunges from relatively extensive cultivated lands into the darkness of a virgin mixed hardwood forest. Even where lands of the Reservation are cultivated by the Indian occupants there is commonly a sharp change between their appearance and those of the neighboring white farmers. To use the analogy of Hewes, there is a sharp "cultural fault line."⁵ The western border of the West Shawano Upland is the terminal moraine of the Wisconsin glacier, the Upland being on the glaciated side. This boundary, a natural one, is nevertheless sharp, and is one marked also by a change in the visible features of the landscape, the local region to the west (unglaciated) side of the moraine being less developed near the moraine. To the east the border of the West Shawano Upland is transitional, extending through a zone wherein the contact between the crystallines and sedimentaries is crossed (though not visible on account of the heavy mantle of drift), until near the city of Shawano the well-settled, highly developed sedimentary Eastern Lowlands of Wisconsin has completely replaced the landscape of the West Shawano type. On the south there occurs another transitional border, in this direction transitional to the glaciated sand country of central Wisconsin; increasing sandiness south and southwest is the key to the eventual appearance of the Sand Region. Decreasing sandiness northward, or sandy loam soils associated with drift derived from granitic rocks rather than from Cambrian sandstones is the index to the border regions within the West Shawano Upland proper. Within the boundaries as outlined and illustrated (Fig. 1) the region has an area of 718 square miles, not one of the largest in area of Wisconsin's geographic regions, but adequate in size as a sample for comparative purposes.

The natural environment of the West Shawano Upland is none too hospitable, as might be supposed from its analogy to northern Wisconsin. Severe winters, short, cool summers, a growing season of 120 to 135 days,

⁵ Leslie Hewes, "The Eastern Border of the Cherokee Country of Oklahoma as a cultural 'Fault Line,'" *Abstract in these Annals*, Vol. XXXII, 1942, pp. 120-121. See also Leslie Hewes "The Oklahoma Ozarks as the Land of the Cherokees," *Geog. Rev.*, Vol. XXXII, 1942, pp. 269-281 (especially the last paragraph and footnote on page 281).

susceptibility to both early frosts in autumn and late frosts in spring, soils which tend locally to be excessively stony, much morainal topography of variable and broken slopes (Fig. 2) and local boggy areas, all are factors not the most favorable for agricultural specialization except of the dairy type. Why, then, was this region, so typically northern in character, settled as thoroughly as it has been, for practically all its land has been claimed by farmers? The lumber companies, except very locally, were able to dispose



FIG. 1.—The West Shawano Upland and the Northern Forest, Hay and Dairy Region. Milwaukee is shown by the blacked-in area on the shore of Lake Michigan, while the location of Madison is indicated by the blacked-in area in south-central Wisconsin.

of their holdings. The region, in its sequent occupance, passed from the Indian to the lumberman to the farmer, while large areas of Northern Wisconsin remained with the lumberman, who, when unable to dispose of his denuded holdings to the agriculturist, dumped the land back upon public ownership (counties) through the medium of delinquent taxes.

REASONS FOR SETTLEMENT OF THE WEST SHAWANO UPLAND

A critical point in the understanding and eventual solution of the problems suggested in the introduction of this paper is the answer to the question in the preceding paragraph. Why was the West Shawano Upland set-

tled and developed when other similar environmental regions of the northern Wisconsin type were not? The answer lies in the realm of geographic location. The West Shawano Upland is (1) the southernmost segment of the Laurentian Highland in Wisconsin. As such, it is (2) geographically adjacent to the well-settled portions of the state which occupy regions of sedimentary rocks. (3) It was crossed, at a very early year for northern Wisconsin, by a road leading northward to an early fort, and later the lumber country. This road led from Green Bay, on the shore of Lake Michigan, to Shawano, then northward. This is highly important when considered in connection with its geographical adjacency to the settled area

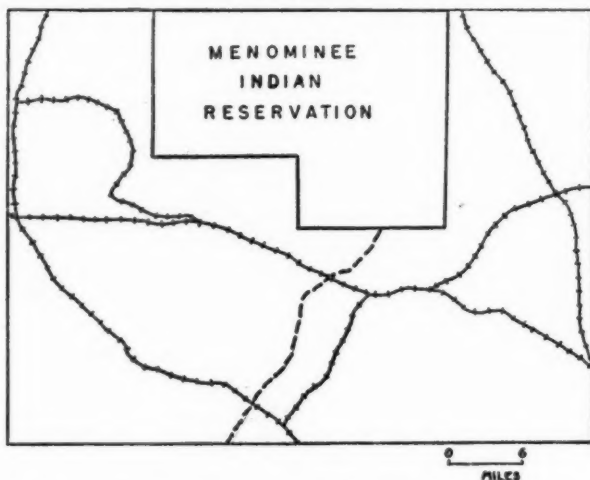


FIG. 2.—Diagrammatic map showing the "barrier" function of the Menominee Indian Reservation. The Reservation is 24 miles in length from east to west, 18 miles at its greatest width from north to south. Railroads by-pass it to the east and west. The dotted line indicates the southeastern border of the West Shawano Upland, the area of the western portion of the map being in the Upland.

to the south. (4) Railroad lines to the North Woods were built across the present West Shawano Upland in order to reach the timbered areas. While the time of railroad building followed the earliest road by some two to three decades, nevertheless the railroads played a more important part in the attraction of settlers to the region than did the road. (5) Most important of all, the basic reason explaining settlement of the West Shawano Upland and lack of settlement farther north, it seems to the writer, is the peculiar geographic location of the Upland, *cut off* from the larger region of northern Wisconsin by the man-made Menominee Indian Reservation. This Reservation effectively cuts the major portion of the West Shawano

Upland from the larger area of northern Wisconsin landscape to the immediate north. (Fig. 2). Moreover (and critically for settlement), the Reservation effectively forced railroads to "bottleneck" through the western portion of the West Shawano Upland in order to reach the larger North Woods area. In other words, the Reservation acted as a "cultural massive," analogous to European crystalline massives and Alpine folding in forcing

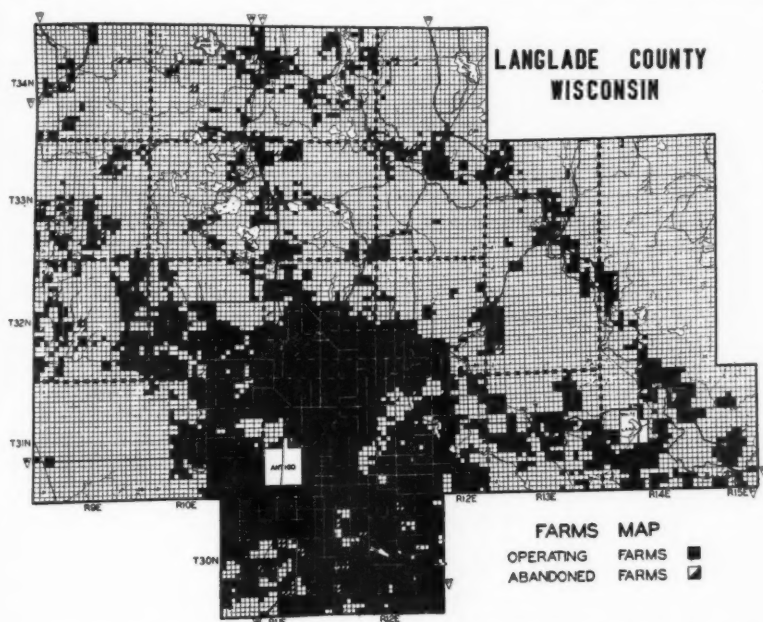


FIG. 3.—The southeastern portion of Langlade County lies to the north of the Menominee Indian Reservation. Note the scattered pattern of farm land in the district. The southern portion of the solidly settled area lies in the West Shawano Upland west of the Reservation, the rest of the solidly settled area in the Antigo Flats. (Map from "Langlade County—Resources and Utilization," Extension Service of the College of Agriculture, Madison, 1934.)

cultural forms of transport to avoid it, and to funnel past it. Negatively the Reservation directed settlement to its eastern and western margins; directly it acted as a buffer to retard and eventually stop settlement at its southern border; directly also it acted to preclude settlement to its north, for settlers then felt "they were getting pretty far north." Even to this day, there is but little agricultural settlement north of the Reservation (Fig. 3); the region immediately north, throughout its white occupancy, has been

relatively inaccessible.⁶ In summary, the net effect of the existence of the Reservation has been both passive and active; its very existence has actively directed settlement around it, particularly to the region on its west, served by adequate highways and railways; its existence has functioned as a buffer to stop settlement effectively at its southern and western margins. Its geographical location has permitted settlement of the crystalline regions to its south, but has retarded settlement to its north (a fortunate circumstance for the northern region, and for the state as a whole).

Finally, why did settlers "take up" the stony, glaciated crystalline upland south of the Reservation in the West Shawano Upland? Adjacency to the reservoir of people on the sedimentary areas to the south in Wisconsin is the chief answer. Accessibility to these areas by rail is another. Simple northward spread from the settled southern sections moved like a heavy liquid slowly overflowing, until blocked by the cultural fault line of the Reservation. All of these common methods of migration were aided and abetted by the pull exerted by lumber companies anxious to sell their denuded lands, by railroad companies anxious for traffic, and by various public agencies, such as the office of the Commissioner of Immigration for Wisconsin, an office long since discontinued, functioning to attract settlers to the northern regions of the state. Conversation with the older settlers of the West Shawano Upland frequently elicits such comments as "back in Dale," "in Bear Creek," "when I was a boy in Manitowoc county," and similar statements.⁷ Added to the northward spread of the American-born was a scattering of foreign immigrants, attracted to the region by certain of the agencies described above, or by other and devious methods, and a considerable colony of Norwegians and of Germans who settled in the Wittenberg community. All told, whether native or foreign born, the influx entered throughout the 1890's and 1900's, dammed up against the Reservation wall, actively engaged in land clearing and agriculture, developed the region to the present stage with the aid of sons and grandsons, and yet has never succeeded in making the almost complete cultural imprint upon the region that other men have been able to plant upon the sedimentary glaciated areas to the southeast and south. Thus, despite a generation or two of

⁶ There are now main highways crossing the Reservation. These were built, however, long after the settlement pattern had been developed. Moreover, the distance through the Reservation to Shawano is relatively long, considering the lack of intervening communities. Furthermore, the few settlers north of the Reservation had been indoctrinated into the umlands of other communities.

⁷ Dale is in Outagamie County, adjacent to the southeast; Bear Creek is in Wau-paca County to the south; Manitowoc is one of the Wisconsin lakeshore counties.

effort, the West Shawano Upland remains a "laboratory of investigation" for those interested in what crystalline northern Wisconsin might have become if it had been settled at the same time, or what it might reasonably be presumed to become if settled at a later date.

THE REGION TO WHICH THE SETTLERS CAME; ITS FUNDAMENT

The first white settlers of the West Shawano Upland arrived in a region of hardwood forests, rolling glacial moraines, elliptical drumlins, till plains, a weaving, undulating knob-sag-and-swell surface (Fig. 4) threaded by



FIG. 4.—A typical marginal moraine in the West Shawano Upland. The moraines of northern Wisconsin are kame-and-kettle moraines, excessively stony because the granites and other crystalline rocks have furnished numerous boulders. They are quite unlike the clay moraines of the Illinois or Indiana till plain. (Courtesy Wisconsin Geological Survey.)

crystal-clear trout streams, headwaters and tributaries of what came to be known as the Embarrass River, a right bank tributary of the Wolf. A mixed hardwood and pine-hemlock forest mantled the uplands. The hard maple provided sap for the sugar bucket, the white pine furnished lumber for the cabin, the home, or the lumber mill. Lowland varieties of trees margined the sphagnum bogs, the latter a forerunner of the typical lowland vegetation so common farther north. The forest litter covered a multitude of glacial boulders (Figs. 5 and 6) as numerous as in New England, for glaciation and crystalline rocks combined to furnish grist that the ice was unable to grind to fine fragments. The soil of brown and grey-brown pod-



FIG. 5.—A corner of a 40 acre pasture in the West Shawano Upland almost completely mantled by granite boulders. While this degree of stoniness is extreme, it nevertheless is representative of certain areas. (*Courtesy Wisconsin Geological Survey.*)



FIG. 6.—A large isolated boulder of granite pegmatite. A boulder of this sort, when seen from a distance, gives the impression of being a small hay stack. (*Courtesy Wisconsin Geological Survey.*)

zolized types was typical of the north, later mapped in large part by the Soil Survey as Kennan Loam, and defined as originating from the glaciation of crystalline rocks. Sandy stretches of soil composed the alluvial plains of the streams, and locally clay, of lacustrine origin, provided a better soils habitat. Of much of this, except land forms and natural vegetation, the original settler was probably unaware. Thousands of glacial boulders were so thoroughly covered with forest litter that only the process of land clearing exposed them; others "grew up out of the ground," as many of the original settlers still insist, following land clearing, the result of the wedging action of frost coupled with the disturbing effects of the plow and surface



FIG. 7.—A former lumber camp in the West Shawano Upland. Note the white pine stump in the foreground, the cut-over in the background. (Courtesy Wisconsin Geological Survey.)

erosion. The setting of the entire area was in the *Dfb* of Köppen, with a winter averaging 20° F., a cold month of 10°, and a short, cool summer, with only the month of July having an average temperature of close to 70°. (Shawano, just outside the eastern border, 69.5; Antigo, just to the north, 68.1.)

Perhaps most of the environmental features except the forest and streams escaped the notice of the earliest settlers—the lumbermen. Logging tended to follow the stream valleys, first because the sandier outwash plains contained the majority of the stands of white pine, the only wood in demand at the start of settlement, and secondly because the streams either served as

routeways for log transportation to down-river mills, as local sources of power for small mills, or as "booming" locations for the storing of logs. Since, however, hardwoods were the chief forests of the region, many lumbermen of the nineteenth century moved farther northward after the pine logging was completed, in quest of more pine. It was thus that the land area of the West Shawano Upland came into the hands of the farmer in a complex pattern, (1) either after logging in certain localities, (2) after removal of the pine and the stripping of hemlock bark for sale to Great Lakes tanneries, but not the complete logging of hardwoods, or (3) directly, i.e., not following a logging stage. The complex pattern and its reconstruction lies beyond the scope of this paper: the end result, no matter what the sequence, was the claiming of the land by farm settlers.*

THE REGION IN ITS EVOLUTION TO THE PRESENT DAY

The farm settlers arrived from southern Wisconsin, from the farms of nearby sedimentary rock areas, and directly from Europe. Some, like the Hulls and Wisemans, had moved from the Waukesha and Dodge county districts of highly developed southeastern Wisconsin, with a stop in the Fox-Winnebago Valley west of Oshkosh; others "spilled over" from Wau-paca, Outagamie, and other adjacent counties; others, of first generation from German parentage moved northward from lakeshore Wisconsin. Added to this American migration, which, unheeding the precepts of Horace Greeley, went north rather than west, were groups from Germany and Norway, low Germans for the most part who even to this day have retained some dialectal vestiges of the old country. The farmer purchased an 80, 120, or 160 acre farm, rarely more. He adjusted his purchase to the rectangular shape of the American land survey, built his roads on section lines, and, so far as possible within the framework of the drumlin and morainal country, shaped his fields to conform with the straight lines of the survey.

The early farmer cleared his fields of trees, stumps, and stones. He built gigantic stone piles, only occasionally a stone wall, failing in this respect to pattern after the New Englander, though in a somewhat similar environment (Fig. 8). He turned his dairy cows loose in the brush and woods, much of it "alleged pasture" rather than productive grassland. He did not attempt to grow wheat; before his coming, Wisconsin had passed through the wheat stage, and was engaged in dairy farming. He planted

* As a matter of fact, the sequence of logging is even more complex than that suggested, since much hardwood logging actually followed farm settlement, and took place within the line fences of the farms themselves. This was both because of a much later demand for hardwoods from the region (the present century) and because of exhaustion of the white pine farther north.

oats, clover, timothy, and corn in his fields, though he soon found that the cool summer precluded maturing of corn, though permitting it to reach a succulent stage usable for silage. By necessity, not just because of trial and error, he recognized that dairying, already established in southern Wisconsin, was the salvation of the area he lived in. His accumulations of capital, whether from forest work or farm, went into capital equipment—barns and cattle. He hoped for and obtained nearby markets in cross-roads cheese factories. In sum, from the 1890's until the present the West Shawano Upland has been evolving and changing. It is not static even



FIG. 8.—A hay field and field of oats, separated by a stone wall built of glacial boulders. Notice the pastured and wooded stony moraine in the background. (*Courtesy Wisconsin Geological Survey.*)

today. But it has had a long enough agricultural history to permit of stock-taking for purposes of regional comparison. Has the two generations of effort been satisfactory, or would the same effort, work, and expended energy have been more productive elsewhere? The answer, while perhaps not completely clear and absolutely concise, is significant in planning for northern Wisconsin. What, then, is the present landscape of the West Shawano Upland, what results have been attained, what forms of production are dominant? Man has here been working with a typically northern environment, and, though it is located relatively closer to market than much of northern Wisconsin, the results of fifty years of effort should tell us much about what might have been accomplished in the northern region. Consequently the present landscape of the West Shawano Upland merits consideration in light of its historical past and its landscape sequences.

THE PRESENT-DAY LANDSCAPE OF THE WEST SHAWANO UPLAND

The present-day landscape of the West Shawano Upland is one of pasture, forest and cropped fields, set on the rolling glacial surface composed of strong morainal systems, flattish till plains, elliptical drumlins, and flat outwash plains (Figs. 9, 10, 11). Everywhere, except on the outwash, the surface is stony to rocky, and particularly so in the morainal and drumlin portions. The representative view includes a wooded sky-line, interspersed woodland and crop-land in the foreground, large basement dairy barns, and dispersed farmsteads. Land in farms includes 73.6 per cent of the total area; the other 26.4 per cent is either woodland not included within farm



FIG. 9.—A representative landscape of the West Shawano Upland—wooded hills, brushy pastures, cropped land, glacial boulders. The scene is on the South Fork of the Embarrass in Shawano County. The hill in the right distance is the long tail of a drumlin. (Courtesy Wisconsin Geological Survey.)

boundaries, waste land, swamp and marsh land, or limited areas included within the village plats. Analysis of the land in farms shows that only 30 per cent of the area within farm boundaries is crop land, 46.9 per cent is pasture land, and 23.1 per cent in all other land uses—woodland, waste land, and swamp land. Regrouping these figures for the entire West Shawano Upland, farm and non-farm, the end result of the forty to fifty years of settlement and farm development in this Kennan Loam soil area is that only 22.1 per cent of the total area is present crop land and 34.6 per cent is pasture land. The remaining 43.3 per cent is the land in other uses, chiefly timber, whether within the farm borders or outside the line



FIG. 10.—A Shawano County farm in a morainal district. Note the farm home, the old log barn on the left and the new dairy barn on the right. (*Courtesy Wisconsin Geological Survey.*)



FIG. 11.—Good West Shawano farm country on a small outwash plain. (*Courtesy Wisconsin Geological Survey.*)

fence. Thus, in round numbers, a fifth of the land is devoted to crops, slightly over a third to pasture, and nearly one-half to woodland, waste land, and marsh. No view of the region is possible, nor would it be complete or representative, without the ever-present forest, farm woodlot, or wooded and brushy pasture land.

The average-sized farm of the West Shawano Upland contains 122.3 acres, of which approximately 36 acres consists of crop land. The farm enterprise is organized around the dairy industry, as the large barns, milk houses, pastures, hay fields, and the dairy cows themselves testify in the areal scene. Crop land is primarily devoted to raising feed for the cattle, only incidentally to crops that are produced for sale off the farm. For the region as a whole, hay is harvested from 42 per cent of the total crop land, oats from 27.8 per cent, corn from 16.1 per cent, and potatoes from 5.9 per cent, these four crops accounting for over 90 per cent of the cropped acreage. All grains (including small acreages of barley and spring wheat) and hay combined constitute 93.1 per cent of the crop land, and all other crops, including potatoes, the remaining 6.9 per cent. The grains are used in entirety on the farms themselves for feed, even the barley and wheat commonly being mixed with oats for cattle and chicken feed. Farm income for the region is thus supplied by the sale of milk and associated livestock products to crossroads cheese factories, village creameries, or the distant Chicago fresh milk market and is not supplied by the sale of crops, except the sale of potatoes.

The cattle of the West Shawano Upland farms, dominantly of Holstein and Guernsey breed, average in numbers 18.2 per farm, including on the average 11.5 milking cows at any one time, the remainder being young stock, heifers under two years of age, and bulls. The statistical averages show 10.7 acres of farm land per milk cow, 3.2 acres of cropped land per cow, five acres of pasture, and half an acre of corn per cow. Combined grain and hay total 2.9 acres per cow.

Animals other than cattle, chickens, and a team of horses are not usual on farms of the West Shawano Upland. Swine are few in numbers, but rather generally distributed; however, the January 1 average is only two mature hogs per farm.⁹ The statistical average for sheep, two per farm, blankets the true regional situation, for only a few farmers maintain flocks of sheep, usually of moderate numbers, while most of the farmers raise no sheep whatever. There is an average of just over a team of horses per farm, 2.3 being the figure.

⁹ Obviously, the number of swine in any region, or the average number per farm will vary considerably, depending upon the date of enumeration.

The farmstead, center of the farm enterprise, is mature enough in age so that it includes a substantial frame house, a large basement barn, 30 by 60 to 80 feet, silo attached, with stanchions and pens in the basement for the cattle, and adequate haymow space above, a milk house, and granary. The buildings show general recency of construction, a factor related to the age of settlement. The barns have been built directly for the dairy enterprise, and have not been inherited from some other type of agriculture (Fig. 12). Barns are commonly kept in better repair than the houses, may often have running water in the drinking cups for the cattle while the house is without



FIG. 12.—Dairy barn of a Polish immigrant on an 80-acre farm in the West Shawano Upland. (Courtesy Wisconsin Geological Survey.)

running water. Other material features show that the income of the family occupying the farmstead is related to the activities carried on within the barn rather than to activities within the house. The ordinary farmer takes more pride in maintaining his barn than he does in the house.

FARM INCOME OF THE WEST SHAWANO UPLAND

The cultural landscape of the West Shawano Upland, with its large barns and medium-sized dairy herds bespeaks a degree of prosperity in the region—not that of southeastern Wisconsin and not that of the true North Woods area, but more like the former than the latter. Capital improvements upon the farms, particularly evident in the buildings and tractors, show that past accumulations have been sufficient to allow them. How have the farmers of the region been able, despite the general harshness of their environment, to

develop certain aspects of the enterprise? Markets for their one main product—milk—is the answer. The crossroads cheese factory entered the region at an early date, furnished a cash market for milk, with monthly payments to each farmer, and served to further encourage him to build up his dairy herd (Fig. 13). Still later in time the Chicago milk market made inroads upon the area, a fortuitous circumstance for the region, and, with larger payments for fresh milk for city consumption, rewarded the farmers with increased incomes (though with additional expenses to meet the requirements of the City Board of Health).



FIG. 13.—Wooded drumlin, wooded and lowland pasture and crossroads cheese factory (at right edge of picture). (Courtesy Wisconsin Geological Survey.)

The West Shawano Upland has, within its borders, three creameries, forty cheese factories, one condensery, and several receiving stations for out-of-state shipments of fresh milk and fresh cream. These plants are the primary markets of the farmer, paying him for his products, and then either manufacturing or selling the raw material furnished by him. It is the existence of these primary markets which has aided development of the region; without them (as in much of northern Wisconsin) the region could not have advanced to its present stage. Seventy-seven per cent of the farm income is derived from the sale of milk alone.

The rural crossroads cheese factory and settlement developed in the West Shawano Upland in association. Like the "chicken and the egg"—which came first? A few settlers, a minimum of clearing, brushy pasture, a few cows—enter a crossroads cheese factory to furnish a local market.

The market increased the desire to maintain more cows, hence additional clearing, improvement of pastures, bettering of herds, more milk production, larger incomes. Clearing of nearby areas resulted in more cheese factories, until at three to five mile intervals the rural factory became a cultural stamp upon the region (Fig. 14), contributing no little to development of the region until a general saturation point was reached with respect to numbers of factories, ability of the farm to maintain cattle and produce milk, and ability of the farm family to provide labor.



FIG. 14.—A view westward from the terminal moraine at the western boundary of the West Shawano Upland. The flat cultivated area in the middle distance is the outwash plain beyond the moraine. The building in the foreground is the Farmers Paradise Cheese Factory, with the cheese manufacturing room in the basement and cheesemaker's living quarters above. (Courtesy Wisconsin Geological Survey.)

The Chicago milk market entered the West Shawano Upland in 1925 due to a series of circumstances beyond the control of the region. The city passed an ordinance barring milk from herds not tested for tuberculosis. Many northern Illinois herds had not been tested. As a result there was a temporary dislocation of the Chicago milkshed; it declined in intensity in extreme northern Illinois, "jumped" extreme southeastern Wisconsin, which furnished fluid milk to Milwaukee, Racine and Kenosha, and obtained milk in part from Shawano and Marathon counties, whose cattle had been tuberculin tested. Competition of the fluid market forced many cheese factories to close, temporarily or permanently, but increased the incomes of individual farmers. While reentrance of northern Illinois into the urban market, following testing, resulted in some dislocations in the West Shawano Upland,

nevertheless the market for fresh cream (rather than whole milk) was retained, cheese factories reopened, and markets for milk continued. By 1936 out-of-state shipments of milk had ceased, but out-of-state shipments of cream has doubled from those of three to five years previous. These regional dislocations in the dairy industry, while upsetting the specific market, did not affect the farm income seriously, permitted capital accumulations to continue, barns to be improved, and equipment added. While the gross farm income has not been high (in the neighborhood of \$1,000 average) it has been offset by lower labor costs, many of the improvements such as the barns having been built in community "barn-raising bees."

RELATIONSHIPS OF CULTURAL AND NATURAL FORMS TO BORDERING REGIONS

The landscape of the West Shawano Upland, as previously described, has cultural forms, natural features, and element complexes related to both southern Wisconsin and northern Wisconsin. It is necessary only to enumerate some of these, basically because of later necessity for purposes of regional comparison.

The large dairy barns, substantial frame houses, cattle densities, silos, cheese factories, and similar evidences of a relatively advanced stage of agricultural development all are forms that are observable farther south in Wisconsin. The high proportion of woodland, of brushy pasture, stony fields, and pastures, and of non-farm land all are features observable in the crystalline northern Highland. The occasional relic log cabin, tar paper shack, or "roof-on-poles" for the sheltering of hay are cultural relics of settlement on farms which have been retarded in their transition—through indifference, lack of initiative or income, inability to wrest a livelihood from excessively stony acres, or similar human factors, for of course as in all regions the human element enters into the local economy (Fig. 15). The landscape has evolved over a fifty to sixty-five year period, the result of geographic and non-geographic factors, of human energies expended in a none too hospitable environment, but in a location and situation favorable for contacts, rural and urban, with regions and markets farther south.

The end result is that the present-day landscape of the West Shawano Upland is composed of a mixture, and intertwining, of the landscapes of northern and southern Wisconsin. Were it necessary to accurately pigeon-hole the complex scene it would be possible to sort out many elements of outside regions; suffice it to say that many of the natural features of the region are those of a typical northern Wisconsin landscape, while most of the cultural features and forms are those of the more mature southern Wisconsin areas. It is this intertwining of features that permits of the "laboratory approach" to the subject of what all of the crystalline highland

of non-sandy northern Wisconsin would have been like had it been settled. Has the settlement and development of the West Shawano Upland been desirable and profitable? It has not suffered wholesale farm abandonment, so presumably the average family has found the region a satisfactory one in which to work. Farmers have been able to derive enough income to add to their capital equipment, thereby, introducing "southern Wisconsin" cultural forms to the region. But has their fifty years of effort been justified; or will future efforts in similar environments be justified on the basis of the regional accomplishments in the West Shawano Upland? *Relatively* the region remains behind other intensive dairy districts, and *absolutely* it remains far behind in percentages of cleared and cropped land. The region forms an ideal laboratory. Let us, then, examine the character of the Northern Forest, Hay, and Dairy Region.



FIG. 15.—A log cabin and log barn farm. (Courtesy Wisconsin Geological Survey.)

THE CRYSTALLINE NORTHERN HIGHLAND

The northern Highland of Wisconsin, a portion physiographically of the Laurentian Upland of North America, is thickly mantled with glacial drift. It is divisible into four geographic regions, three of which possess a sandy soils environment. The fourth, covering by far the largest area, is the Northern Forest, Hay and Dairy Region. This region stretches, with a slight break, from the Minnesota border eastward to the Upper Peninsula of Michigan, is composed of young Wisconsin drift, generally stony in character, is strongly morainal, and set in the short summer phase of the

Humid Continental climate. At one time a major forest region of North America, it is now, as its name implies, a mosaic of second-growth timber, cut-over land, waste land, burned land, reforested areas, and farm land. Farming communities, scattered in location, but arranged dominantly along the major transportation lines, are small, cover but little total area, and within themselves have considerable of the other areal complexes of the region.

The Northern Forest, Hay, and Dairy Region, in its fundament, is much like the West Shawano Upland in all save one respect—a fifteen- to twenty-day shorter growing season. It was mantled with a mixed hardwood and coniferous forest (the famous solid white pine stands of Wisconsin lumber days were located in the sandy regions, or along the sandy river flats and outwash plains which crossed the larger region). Hard maple, birch, pine and hemlock constituted the bulk of the forest stand. The major soils series, the Kennan Loams, as in the West Shawano Upland, is composed of glacial debris gathered from crystalline rock. Large areas of somewhat better soils, the Colby series, are found locally, and considerable enclaves of sandy soils, chiefly glacial outwash are scattered through the region.

The growing season of the Northern Forest, Hay, and Dairy Region ranges from 110 to 130 days, the last figure also being that of the West Shawano Upland. The summers are not appreciably different in temperature in the two regions, average July temperature at nearly all stations being from 66° to 68°, or only two to three degrees less than at stations of the West Shawano Upland (the lowest July average in the region is 66.3°, just 1.8° less than at Antigo, on the northern edge of the Upland).

Northern Wisconsin was logged for two to three decades. The westward sweep of lumbering crossed the region in the 1880's and 1890's, Wisconsin led all other states in lumber production in 1900, then tapered off throughout the decade until 1910. By the outbreak of the first World War logging had come to more or less of a close, though individual mills continued operation until the 1930's, and a few still operate. The farmer entered the region at first with the lumberman. A lucrative occupation was the raising of food and draft animals in the summer for sale to lumber camps, combined with winter work in the woods. The farmer-lumberjack thus kept himself employed throughout the year, while the employment of the typical lumberjack was seasonal. The above type of farming, however, made but little impress upon the region.

Farm settlements began to be established in the 1890's and 1900's. The nucleus was commonly a former lumber town on a railroad. Dozens of such settlements appeared, though not all prospered. Individual lumber companies, in order to dispose of their lands, specialized in sale to certain

foreign groups, thus settlements of Poles, Germans, Bohemians, Estonians and others were founded.¹⁰ Certain settlements have been established as long in this region as in the West Shawano Upland, and in these settled districts the landscape of the present is surprisingly like that of the Upland. A blindfolded traveler, if shown a view in the Butternut community of southern Ashland County, or in some of the farming communities of Price County, might feel certain he was still in the West Shawano Upland. He would see the same kind of stony fields, the same crops, similar barns and even architecturally similar cheese factories. However, a short journey in any direction from one of these points would soon take him into the cut-over surrounding the farming area, and he would realize that the scene he had viewed was but a small part of the total area, a replica of the West Shawano landscape set in a sea of second growth timber and cut-over lands.

TABLE I *

	West Shawano Upland	Northern Forest, Hay and Dairy Region
A. Total Land Area		
1. Per cent in farms	73.6	20.0
2. Per cent in crop land	22.1	5.2
3. Per cent in pasture	34.6	9.8
B. Average size of farms (acres)	122.3	103.3
C. Major uses of farm lands		
1. Per cent crop land	30.0	25.9
2. Per cent total pasture land	46.9	49.0
3. Per cent woodland pasture	29.4	33.7
4. Per cent farm land not used for crops or pasture	23.1	25.1
D. Total of C1, C2, and C4	100.0	100.0

* Data from Wisconsin Crop and Livestock Reporting Service. The calculations were made by townships.

The Northern Forest, Hay and Dairy Region has 20 per cent of its total area in farms, but only 5.2 per cent of its total area is crop land. Considering the farm land itself as the base, 25.9 per cent is crop land, 49 per cent pasture (33.7 per cent woodland pasture), and 25.1 per cent is in all other land uses, chiefly woodland. Woodland of some sort thus constitutes 58.8 per cent of the farmland area. Of the crop land on the farms, only 6.8 per cent is devoted to corn, 20.3 per cent to oats, 57.5 per cent to all tame hays, and 5.7 per cent to potatoes. All grain and hay occupies 91.7 per cent of the crop land and other crops only 8.3 per cent. (Tables I and II.)

¹⁰ One lumber company specialized in the sale of land to Kentucky mountaineers, thus establishing the "Ky Colonies" of northeastern Wisconsin.

PERCENTAGE COMPARISON OF THE REGIONS

The striking differences between the West Shawano Upland and the Northern Forest, Hay and Dairy Region are in the percentages of total land area in farms—one region is rather completely settled, the other not. Excluding this, the percentages of crops, of cropped land, of farm woodland, and other landscape factors are essentially the same, as may be seen from Table I. Essential similarity of the figures is accentuated when it is realized that the West Shawano Upland has had a "long" time in which to attain its present condition.

TABLE II *

Per cent of total crop land in certain crops

	West Shawano Upland	Northern Forest, Hay and Dairy Region
A. Certain specific crops		
1. Corn	16.1	6.8
2. Oats	27.8	20.3
3. Barley	5.2	6.4
4. All hay crops	42.0	57.5
5. Potatoes	5.9	5.7
6. All grains	51.1	34.2
7. Grains and hay combined	93.1	91.7
8. All other crops than grains and hay	6.9	8.3
9. Total of A7 and A8	100.0	100.0

* Data from Wisconsin Crop and Livestock Reporting Service. The calculations were made by townships.

The farms of the West Shawano Upland have only a slightly higher percentage of crop land than the farms of the cut-over north—30 as against 25.9 per cent. All farm pasture land in the Upland is only slightly lower than in the north—46.9 as against 49 per cent, and woodland on West Shawano farms, 23.1 per cent, is practically the same as on the far northern farms, where it constitutes 25.1 per cent. It is thus evident that *on the farms themselves* the percentages of total farm area devoted to these different land uses is practically the same as on northern Wisconsin crystalline farms. The regional differences, however, are notable, for while 73.6 per cent of the *total area* of the West Shawano Upland is in farms, only 20 per cent of the Northern Forest, Hay, and Dairy Region is so used. The notable differentiation between the two regions being compared is thus not between the farm landscapes themselves, but between the non-farm lands. The present figures in the West Shawano Upland should forewarn the planner for the 94.8 per cent of the crystalline north not now in crops.

Livestock comparisons in the two regions differ, for the North contains many farms still in the developmental stage so far as dairying is concerned. The areas that have been farmed the longest have dairy buildings and cattle densities comparable to those of the West Shawano Upland, but this is not true for the whole region (Table III). The average farm of the Northern Forest Hay and Dairy Region has 12.9 cattle instead of the 18.2 figure. Milk cows average 7.5 per farm. As might be expected from similarity of cropped acreage percentages plus fewer cattle per farm in the North there is actually more crop land per milk cow in the Northern Forest, Hay and Dairy Region than in the West Shawano Upland—3.6 acres of cropped land against 3.2, two acres of hay land per cow, 3.1 acres of grain and hay per milk

TABLE III *
Livestock

	West Shawano Upland	Northern Forest, Hay and Dairy Region
A. Livestock per farm		
1. Cattle per farm	18.2	12.9
2. Milk cows per farm	11.5	7.5
3. Swine per farm	2.0	1.2
4. Sheep per farm	2.0	1.5
5. Horses per farm	2.3	1.9
B. Ratios per milk cow		
1. Acres of crop land per milk cow	3.2	3.6
2. Acres of hay per milk cow	1.3	2.0
3. Acres of grain and hay per milk cow ..	2.9	3.1
4. Acres of pasture per milk cow	5.0	6.8
5. Acres of farm land per milk cow	10.7	13.8

* Data from Wisconsin Crop and Livestock Reporting Service. The calculations were made by townships.

cow, and 6.8 acres of total pasture per cow. Hogs, sheep, and horses are fewer, however, both in numbers and percentages, there being only 1.2 hogs per farm, 1.5 sheep, and 1.9 horses, not even a team for the average. West Shawano Upland cattle-crop ratios are lower than in the crystalline northern region, primarily because of the larger number of cattle in the older West Shawano Upland and not because of the differing percentages of hay, grain, and pasture land; in this respect the two regions differ, for the ordinary northern farmer, though in a similar environment, has not as yet accumulated the capital necessary for enlargement and maintenance of his dairy herd, and does not ordinarily have the capital invested as yet in the large barns so necessary for hay storage and winter shelter.

In summary of comparative factors it should be noted and reiterated

that the natural elements of the landscape of the two regions are essentially similar; the cultural elements on the farms themselves are essentially similar and locally almost identical, when the more thoroughly settled northern communities are studied apart from the usual farm average. Here the general landscape similarity ceases, at least in the present time, for the non-farm land of the North, whether cut-over, burned over, forested, or waste, presents a total landscape percentage that cannot be duplicated in the West Shawano Upland. However, the similarities of the farm area landscapes are such that the well-settled region may be used as a basis for forecast, and it would be unfortunate indeed if the experiences of one region were not used for the guidance of the other.

CONCLUSIONS, SUGGESTIONS, AND FORECASTS

The West Shawano Upland gives evidence of having reached an essential maturity as an agricultural region. Land clearing has virtually ceased; an irregular woodlot corner may be added to an adjacent field upon occasion, but the major pattern of cleared and non-cleared land has remained virtually stationary for some time. Certain cropped land, particularly that which is excessively stony, has reverted to pasture, even to brushy pasture. However, chief evidence of the essential "plateau" reached by the region is that of the population trend. As in other agricultural regions farther south, the trend is downward. From 9,459 inhabitants in 1890 the region grew to 14,000 by 1900, 16,000 by 1910, reached its peak of 18,245 in 1920, then declined to 16,722 in 1930 and remained essentially stationary during the depression decade. The peak 1920 population was 109.1 per cent of that of 1930. Declining populations, some scattered farm abandonment, particularly farm consolidation and mechanization, all tended to stabilize conditions within the region.¹¹ Having attained probable maturity the region has reached a "climax" (at least under present economic conditions), and hence can serve as the laboratory for consideration of what kind of a region the Northern Forest, Hay and Dairy Region may become.

The northern region, unlike the West Shawano Upland, has continued its population increase. The population trend has been steadily upward since 1890, and the number of inhabitants in the 1920 and 1930 census years was virtually the same. Land clearing has continued, at a rate which is

¹¹ The writer has specifically excluded World War II years from the study. Chief result of the War has been increased milk production with the setting up by the government of greater goals for the dairy industry. Part of the increase has been obtained by selection of better grade cattle, yielding more milk per cow, and part by increased attention to modern feeding practices.

less accelerated than in early years of settlement, but nevertheless steady. It hesitated in the boom 1920's, the city proving an attraction for many, but resumed in the depression 1930's with the return of many a native son. It is conceivable, and probable, that in time the same general saturation point will be reached on the 20 per cent of the region that is in farms as has been reached in the West Shawano Upland. Planning and guidance must be (and is being) provided for the 80 per cent *not in farms*, as well as for a certain proportion of the present farm land that is (1) definitely sub-marginal; (2) on scattered outlying woods farms, far from "going communities" with established community services, and (3) for the communities removed from easy market contacts.

Such being the case, as ample evidence in the form of zoning laws and regulations indicates, why did not the West Shawano Upland have the same problems in its development as are possessed by the Northern Forest, Hay and Dairy Region today? Historical and economic factors were different in the regions. (1) The West Shawano Upland was settled at a time when clearing costs were less, especially when considered with relationship to cheap family labor, to alternative opportunities for employment and to chances for governmental employment or subsidies. (2) The West Shawano Upland was settled rather solidly, not sporadically, as in the Highland. Its services in the form of roads, public utilities, schools, and churches could be and were provided for solidly settled sections, not for isolated communities. (3) The West Shawano Upland area, passing to the farmer from the lumberman, did not face the problem of tax delinquency of cut-over land, a burden thrown on the counties of the Northern Forest, Hay and Dairy Region during the 1920's, and a burden that proved too much for the financial ability of the tax-paying farms, many of which were then themselves forced to the delinquent roll. In sum the fortunate accident of time permitted development of the West Shawano Upland to its present landscape stage; the accident of time retarded areas farther north when they started along the same path.

What is the present attitude toward aiding and abetting settlement in the crystalline Northern Highland? The answer is found in the Wisconsin Rural Zoning Law. Large acreages of the north are closed to agricultural settlement (1) because they are sub-marginal for "all time," being rocky, swampy, or deficient in some respect, (2) because they are sub-marginal under the price conditions at the *time* of the enactment of the zoning ordinances in individual counties, or (3) because they are isolated—i.e., far removed from existing "going" communities. The costs of maintaining roads to them, summer and winter, of county services (schools, health, etc.)

are prohibitive. Other acreages are not closed to the settler.¹² Some of these open lands are good, much is typical Kennan Loam area, a great deal is isolated, but presumably many areas can, if necessary, be settled. If settled they may become centers of future "West Shawano Uplands." The question to decide, obviously, is "Do we want future areas of this type?"

The writer sees both sides of the above question. The West Shawano Upland of today is an asset, not a liability. It is a "going concern." The inhabitants, presumably, are happy and satisfied with their lot. They are farm owners, have comfortable homes, attractive farmsteads, big barns, Holstein and Guernsey cattle, access to markets, monthly milk checks, community services, and similar amenities of life. These things they have obtained by two to three generations of back-breaking work in an environment none too hospitable. Many of the original settlers remain to tell the tale. Despite all their work of clearing they do not have a central Indiana, a northern Ohio, southeastern Pennsylvania, but they have a relatively prosperous region. Would the same region have been cleared today, or in the 1920's or 1930's under different economic conditions? One does not know, but may not.

The opposite answer to the question posed above may be equally defended. Why encourage additional land clearing in the Northern Highland when, as in the 1930's, it was said we had too much land under cultivation, when, under World War II conditions, we are producing more and more food from less acreage than was under cultivation some years ago, and producing it with fewer farm families and presumably less labor? In 1934 the National Resources Board mapped some of the non-settled crystalline upland of the North as suitable for settlement (chiefly the Colby soils area, however), and so reported to the Resettlement Administration. Yet the Wisconsin Agricultural Experiment Station reported that costs of clearing the land would probably run to \$100 an acre. With such costs the land had better be zoned, at least for a time, against agriculture. The *time* factor differs from that of the West Shawano Upland. Suppose the region was settled, and like other northern communities, began unwittingly to pattern after the West Shawano Upland. After fifty years of effort in the Upland 22.1 per cent of the total land area is crop land, 34.6 per cent is pasture, and 43.3 per cent is woodland, brush and swamp land, useful of

¹² Some land that should be closed has been left open. Again the human factor enters the picture. Some town chairmen, not favorable to zoning, have been able to keep the lands of their townships open to settlers. Individuals and groups of this sort furnish a nucleus for combatting the zoning ordinances.

course in part for timber and fuel to supplement the farm income. Fifty years of clearing in southern Wisconsin resulted in more than 22 per cent of crop land, granting even the differences in the type of forest land to be cleared. The southern regions had greater potentialities in many respects—more productive soils, longer growing season, better access to markets. If, after fifty years of effort, the West Shawano Upland has not advanced farther than it has, even though it is a Laurentian Upland area of glacial deposition rather than of glacial erosion, should agriculture be encouraged in its areally larger twin environmental region to the north?

In conclusion, the writer, without forecasting whether the North will or will not develop, without stating dogmatically whether it should or should not be developed in the long run of a century or two centuries, would like to reiterate a few basic points in the regional comparison. It is fortunate for the state of Wisconsin at present that the northern region is as it is and has not developed farther than it has; there are enough financial and regional burdens within the entire Great Lakes Cut-Over Region without wishfully hoping for more. The regional problems of the present must be solved, and it is hoped are on the way to being solved. Zoning must not be relaxed in the face of possible pressures likely to develop following the War. Geographically there is, however, a "northern region of settlement" of 718 square miles, the West Shawano Upland. No master plan should be drawn for the large northern area without intensive study of what has happened in an existing environmentally similar region. The West Shawano Upland is the laboratory. Let us hope that it will be used as such, and that the regional geography of an existing area will contribute its quota of information to the regional planning of a future area.

A New Production Map of the Appalachian Bituminous Coal Region

RAYMOND E. MURPHY AND HUGH E. SPITTAL*

The Appalachian Bituminous Coal Region is recognized as the greatest storehouse of high-rank coal in the United States and, very possibly, in the entire world.¹ In peace and in war this conveniently located source of superior coal has played a stellar role in the nation's development. The extent of coal-bearing formations within the region has frequently been shown on maps (Fig. 1), but the mapping of production has been largely neglected. The authors of the present article wish to present a *coal-mining intensity* map of this critical region, a map that gives a more exact picture of the location of production within the area than has been published before. And they wish to point out, at the same time, some promising kindred lines of investigation.

SOURCES OF DATA

The coal-mining intensity map is based primarily upon county production data, since counties are the smallest units by which such information is published. The two standard sources for such county data are the Minerals Yearbook of the United States Bureau of Mines and the publications of the Bureau of the Census. For 1939 these two divisions cooperated in gathering and publishing a single set of data.

The year 1939 was chosen rather than a later year partly because it was a pre-war and hence presumably "normal" year. Moreover, it was a Census year, and studies of the evolution of the coal production pattern are planned that will involve the use of comparable production maps for the various Census periods as far back as records are available. And, finally, since it takes several years for complete production figures to appear in print it was more feasible to get reasonably complete data for 1939 than for a later year.

The Bureau of Mines and the Bureau of the Census have an unfortunate limitation that stands in the way of making a really complete production

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¹ Marius R. Campbell, The Coal Fields of the United States, U. S. Geol. Survey, Prof. Paper 100, p. 11, 1929.

map. Where there are less than three producers in a county, data are not revealed since it is considered that this would amount to disclosing individual returns. Instead, the data for the county are combined with those of one or more other counties in the same state. Often, of course, the counties thus grouped are minor producers, but this is not always the case. For example, the data for Marshall and Ohio Counties, in the Panhandle of northern West Virginia (Fig. 2), were combined for 1939 even though the

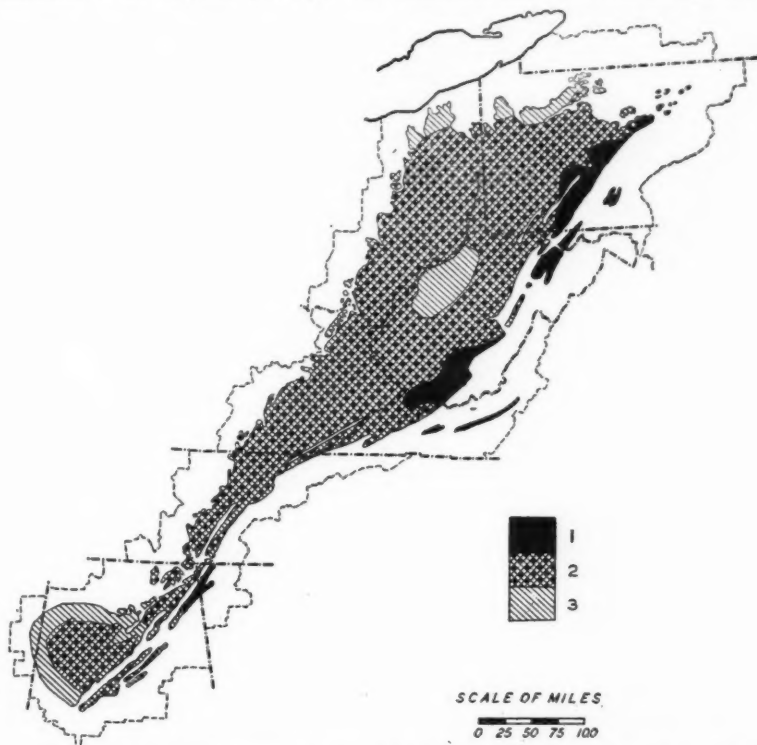


FIG. 1.—Approximate extent of area underlain by coal-bearing formations. The broken line represents the outer limit of counties shown in Figures 2 and 3. Numbers have reference as follows: 1. Areas underlain by low-volatile bituminous coal prized for its "smokeless" quality; 2. Areas underlain by medium-volatile and high-volatile bituminous coals of known present or future value (includes much of the best "coking" coal); 3. Areas of medium-volatile and high-volatile bituminous coals that are considered of doubtful value because they are underlain by formations in which little coal is known or because the coal beds in these areas are thin or irregular and only locally thick enough to work. (Based chiefly upon a map of the coal fields of the United States by Marius R. Campbell, U. S. Geological Survey, 1917.)

aggregate for the two exceeded 2 million tons. Altogether, there were some fifty or sixty producing counties throughout the Region for which separate data were not given. For a reasonably complete picture of production, therefore, additional sources had to be consulted.



FIG. 2.—Location map. Numbers and letters have reference as follows: Pennsylvania counties: 1. Allegheny, 2. Cambria, 3. Fayette, 4. Greene, 5. Sullivan, 6. Washington; West Virginia counties: 7. Brooke, 8. Logan, 9. McDowell, 10. Marion, 11. Marshall, 12. Monongalia, 13. Ohio, 14. Raleigh, 15. Wetzel; Kentucky counties: 16. Harlan, 17. Leslie; 18. Tazewell County, Virginia; 19. Jefferson County, Alabama; Coal fields: A. Brushy Mountain, B. Broadtop.

Fortunately, there are various state reports that help to complete the production picture. State geological surveys and state departments of mines, not subject to the same restrictions as the federal agencies, publish data on production and employment in coal mines by counties. Though the state

production total thus obtained was often not in exact accord with the state total shown by the United States bureaus, the individual county figures gave a proportional basis for separating the county groupings of the federal bureaus. Even where the individual state publications themselves grouped some minor counties, these were rarely the same counties grouped by the Census and the Bureau of Mines, and comparison of the two groupings resulted in separating out most of the county totals.

Several groupings defied division even with the additional evidence furnished by the production data in state reports. Here correspondence with local officials permitted some further breakdowns. A few production figures were furnished with the specific provision that they were not to be revealed in exact form but could be used for making a map. The number of coal miners per county as shown by the Census helped in apportioning production in a few instances, but since miners could live in one county and work in another such employment figures have decided limitations. Finally, in very rare cases, data had to be broken down arbitrarily with little supporting evidence. Such estimates would have been more accurate if based upon field work, but the instances of this sort were so few and the tonnages involved so small that such sources of error in the map are negligible.

LIMITS OF THE REGION

Questions arose as to the exact limits of the Region. In addition to the main contiguous area underlain by bituminous coal there are various smaller, isolated fields along the eastern edge, fragments of coal-bearing formations left as outlying islands in the Ridge and Valley country (Fig. 1). There are several fields of this sort in Alabama, and farther north there is the Brushy Mountain Field in Virginia, and the Broadtop Field and several others in Pennsylvania. In all of these, however, the coal, though low in volatile matter, is more like that of the eastern edge of the main bituminous coal area than it is like the coal of the Anthracite Region of Pennsylvania. Therefore, these fields were considered as part of the Appalachian Bituminous Coal Region in making the production map. The only exception was a small field in Sullivan County, Pennsylvania, the Bernice Basin, the coal of which is so nearly anthracite that it is so classified in production statistics.

PRESENTATION OF THE DATA

To present the information to best advantage various types of symbols were considered. Clusters of dots, even when in orderly rows, presented the obvious disadvantage of suggesting a wide areal distribution of production over each county. The information available was merely total county

production, all of which might have come from one corner of the county or even from one mine. Even more serious was the difficulty of getting the necessary "range"; and the use of proportional discs, cubes, or spheres all faced this same problem. McDowell County, in extreme southern West Virginia, produced over 20 million tons in 1939. On the other hand a considerable number of counties throughout the Region produced less than 2,500 tons. The problem was intensified by the fact that some very small counties had large tonnages. For example, Brooke County in the West Virginia Panhandle, with an area of only 89 square miles, produced a million and a half tons. If the proportional symbol for this county were kept small enough so that it did not seriously overlap the county boundaries the symbols for many of the minor producing counties would be too small to be shown on the map. This was considered especially undesirable since one of the chief advantages of the present study is the completeness of the production data collected. It was finally decided that some sort of pattern was best suited to present the information.

County tonnages were first divided by county areas in order to rule out the factor of size. The advantage of using a tons-per-square mile ratio instead of an actual tonnage figure is that the ratio really represents intensity of production. If, on the other hand, county production figures were used, uncorrected for area, then small counties such as those of eastern Kentucky would be handicapped as compared with the counties of western Pennsylvania, which average a considerably greater area. It should be kept in mind, however, that the result in each case is a ratio, and that there is no intention of implying evenness of production over any county.

In arriving at the tons-per-square mile ratios a special problem arose with respect to the edges of the Region. For example, the coal-bearing formations of the Appalachian Bituminous Coal Region cover only the western half of Tazewell County, Virginia (Figs. 1 and 2). Obviously, the 3 million-ton production of this county must have come from the western half, and the ratio for this half alone is 11,000 tons per square mile as compared with 5,500 for the county as a whole. Why not show a pattern in the western half of the county only, and there use the larger ratio that is known to prevail? By the same method most of the "edge" counties could be shown more truly than by the use of total areas of counties.

The disadvantage of correcting the border counties in the manner described is that this carries the implication of a similar refinement of information all over the map. By inference, for example, a county that lies entirely inside the Region has a production that comes from all over the county, when as a matter of fact only the most detailed research in the field

TONS PRODUCED PER SQUARE MILE
OF TOTAL COUNTY AREA

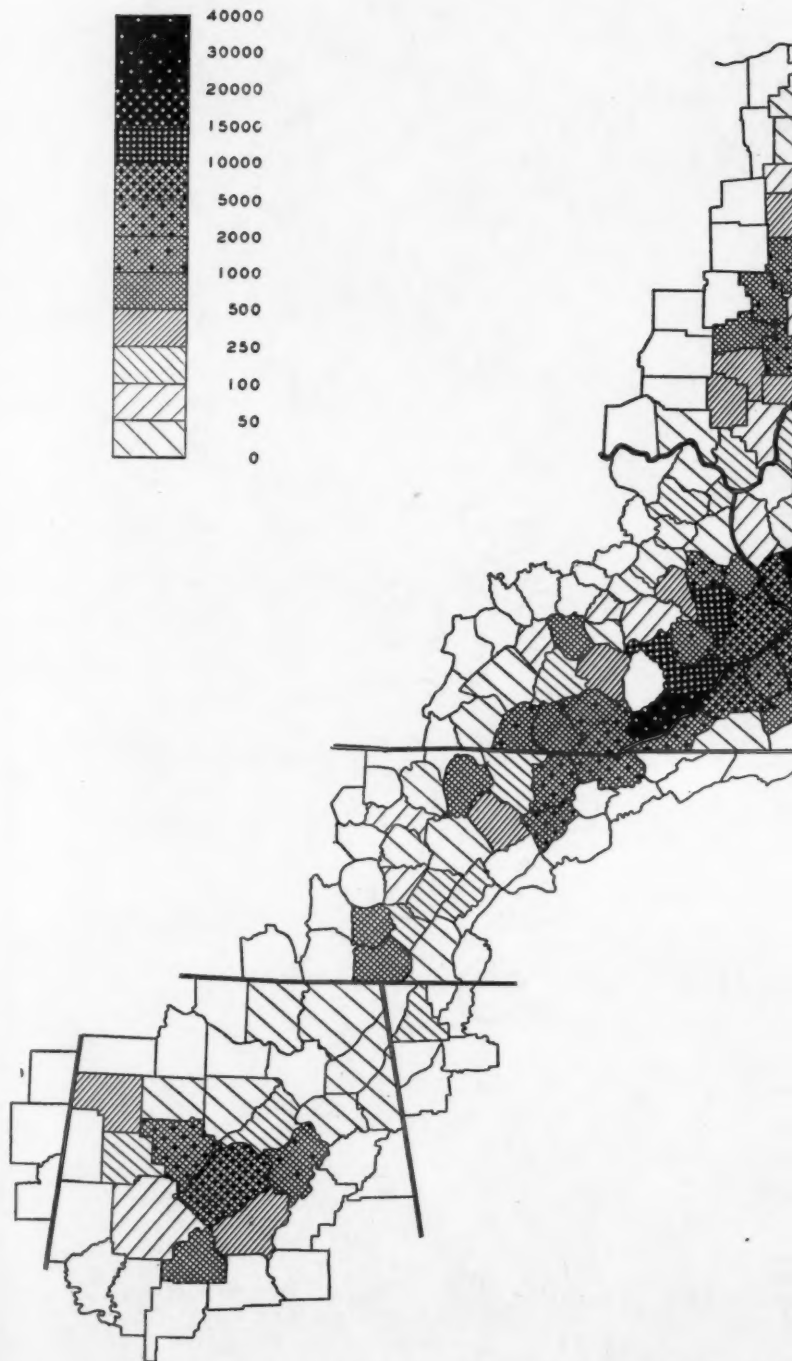
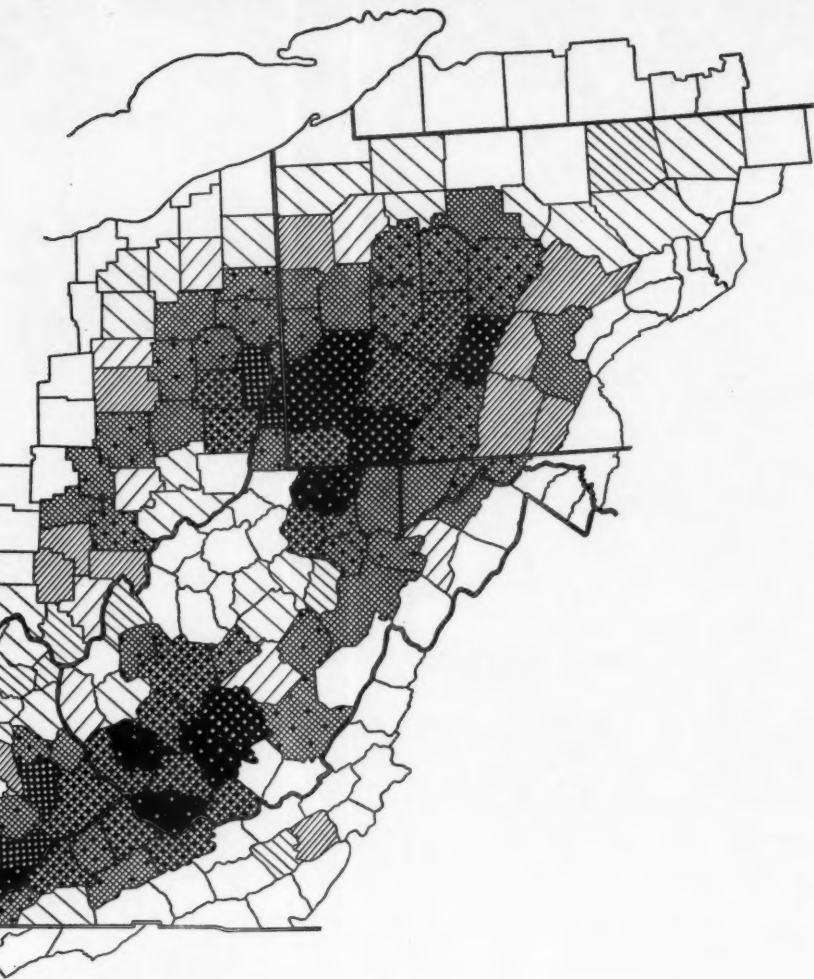


FIG. 3.—Production Intensity Map of the Ap



INTENSITY
OF
COAL PRODUCTION

APPALACHIAN BITUMINOUS COAL REGION

1939

SCALE OF MILES

0 25 50 75 100

REM. & M.S.



could give even an approximation of the location of production within the various "inside" counties. It was considered better from a statistical point of view, therefore, to divide the production of each county by the total area of that county regardless of the fact that a portion of the county might be known to be non-producing. The resulting loss in possible refinement along the edges of the Region is compensated by the fact that the map does not imply more detailed information than the authors actually possess.

Further problems were involved in applying the spatial symbols. The number of distinct gradational patterns has a practical limit, and the question arose whether to make the class intervals narrow at the lower end of the scale or at the upper end of the scale or to attempt a fairly uniform system. Obviously, if the interest is chiefly in the smaller producers, then many divisions should be made at this level thus throwing all of the largest producers into a single pattern. Using the reverse system would throw all of the counties with small ratios into a single pattern but discriminate closely between the major producers. Of course two such maps would give much more information than any single map, but for the present purpose one map using twelve patterns was decided upon.

WHAT THE MAP SHOWS

The map presented with this article (Fig. 3) shows the intensity of coal mining throughout the Appalachian Bituminous Coal Region.² Every county that reported commercial production is represented by one or another of the patterns. Counties shown without any shading, such as those in northwestern West Virginia, had no commercial production.

There is, apparently, a large producing area stretching from Pennsylvania into Tennessee, interrupted by a marked patch without production in northwestern West Virginia. Far to the south is a second, much smaller producing area in north-central Alabama. Or, we might consider that there are three principal areas of production: one in southwestern Pennsylvania,

² A somewhat similar map can be made by using a ratio of coal miners per square mile. In fact it is an easier map to construct than one based upon tonnage since the Census publishes occupational information by counties without apparent restriction.

On the other hand such a map has certain marked disadvantages. For example, coal miners are mobile and they may live in one county and work in the next. Or, a man may give his occupation as coal mining, but he may be temporarily unemployed and living in another county. As a result of such factors many non-coal-mining counties have coal miners residing in them. These objections are valid chiefly for the counties in the lower producing brackets. A more serious objection to the use of the employment basis is that on this basis the most mechanized and most efficient areas appear less important than they really are since they employ fewer men per unit of production. The authors concluded, therefore, that tonnage per square mile was a more valid and objective basis for depicting the location of coal production.

Ohio, northern West Virginia, and Maryland (the "Northern Fields"); a second in southern West Virginia, western Virginia, eastern Kentucky, and adjacent counties in Tennessee (the "Southern Fields"); and a third in north-central Alabama.³

The Northern Fields constitute a relatively old producing section. Most of its fields were producing commercially a century ago and many are long past their years of maximum production. No county in this area is in the 30,000 to 40,000 tons-per-square mile class; but Marion County in northern West Virginia is in the second production-intensity class; and Brooke and Monongalia Counties, West Virginia, and Allegheny, Cambria, Fayette, and Washington Counties, Pennsylvania, are in the 15,000 to 20,000 tons-per-square mile class. This producing area grades into counties of lesser mining intensity in Pennsylvania, Ohio, West Virginia, and Maryland.

Separating the northern producing area from the Southern Fields is an interesting island of eleven contiguous non-producing counties. Much of this non-productive section has been explained by Campbell as having been an area of deep water surrounded by coal swamps.⁴ He points out that drilling for oil and gas in the area has revealed a general absence of coal. This is reflected in published calculations of original resources for West Virginia by counties.⁵ Some of this group of counties are listed as having had no original coal resources whatever and most of the others had very limited resources.

The producing area referred to as the Southern Fields is notable for the recency of its development as compared with the Northern Fields and for the presence of more counties of high production intensity. Here are the only counties of the entire Appalachian Bituminous Coal Region that are in the 30,000 to 40,000 tons-per-square mile class: McDowell and Logan in southern West Virginia. The former, which first became a producer in 1889, has increased its production five-fold since the turn of the century, and Logan County did not begin substantial production until 1907 or 1908. Raleigh County, southern West Virginia, in the 20,000 to 30,000-ton class, has had about the same history; and Harlan County in eastern Kentucky,

³ A division into the Northern Section, the Middle Section, and the Southern Section would appear more logical, but use of the terms "Northern Fields" and "Southern Fields" for the northern and middle areas respectively is standard practice among coal mining men and others interested in coal statistics of the Appalachian Bituminous Coal Region. The Alabama area is considered separately, not included in the Southern Fields since its markets are different and it does not compete directly with either of the other areas.

⁴ Campbell, *op. cit.*, p. 13.

⁵ See annual reports of the West Virginia Department of Mines.

in the same intensity class as Raleigh, was not an important producer until the first World War. A number of additional counties in this area are substantial producers though of slightly less intensity.

The case of Leslie County, Kentucky, bordering Harlan County on the northwest, reflects the pioneer nature of the coal production of the Southern Fields. Leslie County was not a commercial producer in 1939 "because it has no railroad facilities as yet. Our information is that at some time in the future Leslie County will be a quantity coal producer, but this development is several years off."⁶

The third producing nucleus of the Region lies somewhat north of the center of Alabama. Its total production is far less than that of either the Southern Fields or the Northern Fields. Sixty per cent of the production comes from one county, Jefferson, in which Birmingham is situated, but the intensity even in this county is not comparable to that of the other two areas. Jefferson County was not an important producer until 1889. Thus, this most southerly producing area is intermediate between the other two in the length of time it has been an important factor in the production picture.

RELATED PROBLEMS

There are, of course, innumerable lines of geographic investigation with respect to the coal resource and man's adjustments to it in this immense region.

The coal mining intensity map suggests the problem of evolution of the pattern presented. Why did the Region develop as it has: beginning at the north, then at the south, and last of all in the middle where coal resources are particularly great and easy to mine? A series of intensity maps, one for each Census period since the beginning of production, is now being prepared and should furnish a basis for studying this problem.

The same problem is being attacked in another way through a study of the center of production for each Census period. The Northern Fields are reported to be losing their markets to the Southern Fields. The "center" studies reduce this shift to definite, measurable terms and permit some projection into the future.

Closely identified with these lines of investigation is a study of the evolution of the railroad pattern of the Appalachian Bituminous Coal Region. To what extent did the coal mines merely take advantage of railroads built for other purposes, and to what extent were the railroads built with this rich freight specifically in mind?

⁶G. M. Patterson, Chief of the Department of Mines and Minerals, State of Kentucky, personal communication, 1942.

The problem of origins of the coal miners is another interesting field for investigation. To what degree are the mining districts peopled by workers of southern and eastern European descent? Are the proportions of these workers originating in the various countries different for the Southern Fields than for the Northern because of the difference in the time of development of these two sections? To what extent have negro workers invaded the coal mines?

A map of original coal resources by counties would be an exceedingly useful contribution to studies of the Region since it would furnish a definite basis for predicting future changes in the pattern of coal mining intensity. Greene County, Pennsylvania, for example, although it had originally, and still has, greater coal resources than any other county in the State, is in the fifth production-intensity class because much of its supply is too deeply buried to be mined at a profit in competition with more easily accessible coal elsewhere. Much the same condition seems to prevail in adjacent Wetzel County, West Virginia. Though such resource data exist for Pennsylvania, Maryland, Ohio, West Virginia, and Virginia and might be synthesized into a map, no comparable calculations have as yet been made for the states farther south.

Another promising line of investigation is based upon the fact that the coal resource is, after all, ephemeral. There are portions of counties and even whole counties in the Northern Fields that have entirely used up their natural endowment of coal. These areas with their ghost towns and other evidences of decline are afflicted by a malady that is destined to spread. Much of the Region must some day face the same problem. The areas where the coal supply is already exhausted or nearly so should be mapped and studied as type cases. Here may be an opportunity for the geographer to make a constructive contribution: to develop some facts or principles that may be useful in the much more extensive readjustments that face the Appalachian Bituminous Coal Region in the future.

The Pennsylvania State College

May, 1944

A Linear-Distance Map of Farm Population in the United States*

EUGENE MATHER

The objective of this study is to depict by isarithmic lines patterns of linear distances between nodes of farm population (farmhouses) in the United States at the time of the 1940 census.

THE CONCEPT

It is difficult to represent population statistics adequately on maps. If resources and time permitted, we could carefully locate each residence and thus give a fair portrayal of the density of population. Obviously if an extensive area is involved this procedure cannot be followed. Therefore, we have usually resorted to the method which places population in a direct relationship with a unit of square measure, such as the number of persons per square mile. However, this method entails difficulties of visualization for the reader. In 1940, James A. Barnes and Arthur H. Robinson called attention to the fact that, "One cannot possibly picture 40 or 60 persons equidistant from one another spread out over a square mile. Instead the map reader must conjure up his own mental 'yardstick' and compare such figures with known areas of density, a procedure that is often very misleading and inaccurate. If the value to be represented can be reduced from a ratio between people and area to a simple linear distance between people or between residences (which are the ultimate in dot maps), it follows that the resulting map is far easier to interpret. As the farmhouse forms a node of population concentration and is one of the significant cultural features of the landscape, the reason for the arbitrary conclusion that distance between farmhouses is more valuable than distance between persons is obvious."¹

* This study was made, with the assistance of Helen L. Smith, in connection with a graduate seminar on methods of population representation under the direction of Professor Glenn T. Trewartha, Department of Geography, University of Wisconsin, who sponsors its publication.

¹ James A. Barnes and Arthur H. Robinson: A New Method for the Representation of Dispersed Rural Population, *Geogr. Rev.*, Vol. 30, 1940, pp. 134-137.

THE FORMULA

The formula employed in determining average distances between units (in this instance, farmhouses) within an area is $D = 1.07 \sqrt{\frac{A}{n}}$, in which A represents the total area, n the number of farmhouses, and D the average distance from one farmhouse to the nearest six farmhouses.²

The originators of this concept tested their procedure against existing conditions by making actual measurements of distances between farmhouses on topographic maps representative of irregular farmhouse distribution. Re-checks of the formula on different areas by the author of this study corroborated Barnes' and Robinson's conclusion that the distances as calculated by the formula and as determined by actual measurement were the same.

BASIC DATA AND PROCEDURE

The arbitrary assumption was made that each farm had one population node, the farmhouse. The number of farms for each civil division was procured from the 1940 census.³

The formula can be applied readily to a restricted area as was demonstrated by the map of the Driftless Hill Lands in Wisconsin, Minnesota, and Iowa and the map of southern Ontario made by Barnes and Robinson. However, the time consumed in the application of this formula to an extensive area, such as the United States with the individual unit being the county, may be so great as to discourage its use. Therefore, a time-saving technique is highly desirable if this concept is to be widely used on areas of more than limited size. While a considerable economy in time can be realized through the use of a slide rule or a mechanical calculating machine, the most efficient device for such a problem is the nomograph. Time-checks were made of three methods in order to illustrate the relative value of the nomograph. Calculations which took 100 minutes of time by a "long-hand" mathematical procedure employed in conjunction with square-root tables, could be made in approximately 25 minutes if a mechanical calculating machine or slide rule were used. When the nomograph was used this time

² For the derivation of the formula see Barnes and Robinson, *op. cit.* In a re-study made by the author with the aid of Professor M. H. Ingraham, Department of Mathematics, University of Wisconsin, the original formula, $D = 11.1 \sqrt{\frac{A}{n}}$, developed by Barnes and Robinson, was altered slightly.

³ The 1940 census report defines a farm as "all the land on which some agricultural operations are performed by one person, either by his own labor alone or with the assistance of members of his household or hired employees." In addition, to be classified as a farm, the tract of land must embrace 3 or more acres unless its agricultural products for the year 1939 had a value of at least \$250.00.

was reduced to about 2.6 minutes. In other words, the ratio of time consumed by these three methods was about 40:10:1.

In constructing this nomograph the "area in square miles" was plotted along the left margin, the number of farmhouses along the right, and the dial was placed in the center.⁴ In this instance the nomograph was used to make three mathematical calculations, i.e., multiplication, square root, and division, all in a single operation. The advantage of the nomograph increases proportional with the number of mathematical calculations required, and its value as a technique for numerous geographical problems can hardly be over-estimated when time is at a premium.

The average distances between farmhouses as read on the nomograph were plotted on an Albers Equal-Area Projection of the United States, scale 1:5,000,000. The isarithmic interval was selected by means of a frequency graph which scaled the number of counties on the axis of ordinates and the distances between rural population nodes on the axis of abscissas. Then the isarithms were drawn in accordance with the "spot-height" concept; i.e., if the county had a linear-distance value of 0.61 mile between farmhouses, the isarithm of that value was passed through the center of the county and not around its border.⁵ (Fig. 1).

Minor civil divisions were used as the basic areal unit for the state maps of California, Illinois, and Alabama; for the map of the United States the county unit was employed. While the state map of California has considerably more refinement than is depicted for California on the map of the United States, the latter shows the prominent features indicated on the former. Moreover, if minor civil divisions had been used for the entire country the mass of detail would have greatly obscured the broader regional aspects (see the maps of Illinois and Alabama). Note, though, that the Illinois map *does* indicate the effect of Chicago; this *does not* appear on the map of the United States since it had a larger basic areal unit. However, for most of the country the size of the county unit is suited to this particular problem. (Figs. 2, 3 and 4).

While the average size of farm in most sections of Alabama is smaller than in Illinois, the average distance between farmhouses is approximately

⁴ For information on the principles of the nomograph, its construction, and its uses, see John W. Alexander and George A. Zahorchak: Population-Density Maps of the United States: Techniques and Patterns, *Geogr. Rev.*, Vol. 33, 1943, pp. 457-458; H. J. Allcock and J. R. Jones: *The Nomograph*, 2nd edit., London, 1938; and Maurice d'Ocagne: *Traité de nomographie*, 2nd edit., Paris, 1921.

⁵ For an explanation of the frequency graph and the "spot-height" concept see: John W. Alexander and George A. Zahorchak, Population-Density Maps of the United States; Techniques and Patterns, *Geogr. Rev.*, Vol. 33, 1943, pp. 458-461.

the same since Alabama has more non-agricultural land than Illinois. Most of this non-agricultural land is in small scattered pieces and consequently does not affect appreciably the patterns of distances on the map of Alabama.

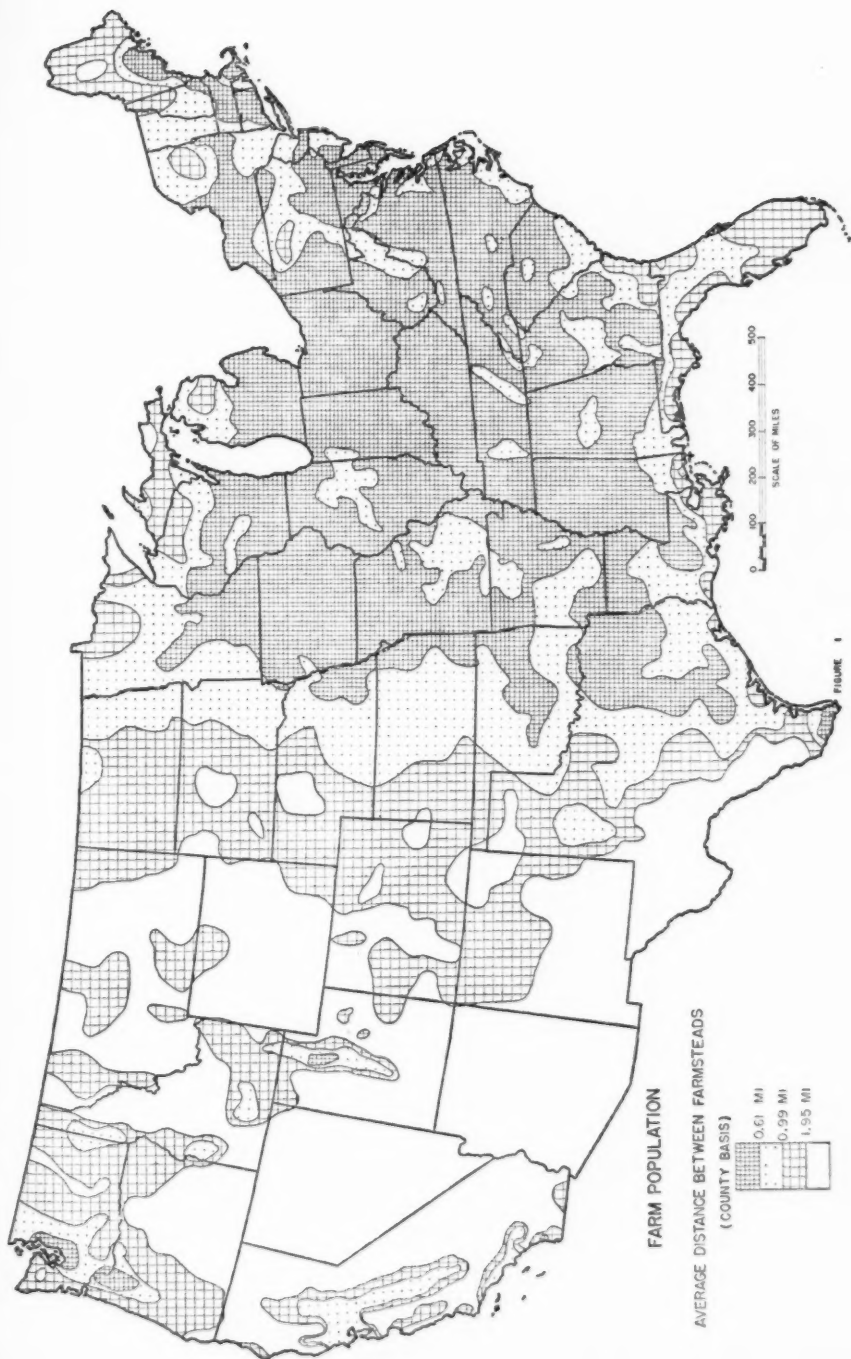
PATTERNS OF AVERAGE DISTANCES BETWEEN FARMHOUSES

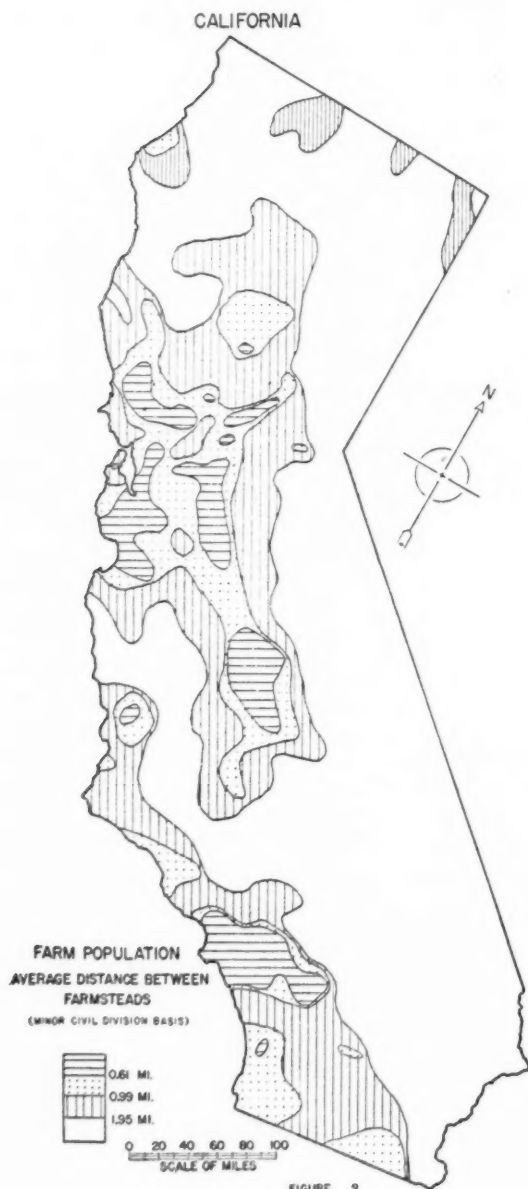
The most distinctive feature of the United States map is that nearly all counties lying east of Köppen's boundary separating the humid climates of the east from the dry climates of the west (approximately the 100th meridian) have an average distance between farmhouses of less than 0.99 mile, and the average distance for almost all counties west of this boundary exceeds 0.99 mile.

Most of the counties in the eastern division have an average distance between farmhouses of less than 0.61 mile. The sections having the greatest distances between farmhouses are in the "cutover" area of Minnesota, Wisconsin, and Michigan; the Adirondack Mountains; Maine; the rougher portions of Pennsylvania; the poorly drained coastal sections of Texas and Louisiana; and the Florida Everglades. The principal areas between the 0.61-mile isarithm and the 0.99-mile isarithm include a north-south belt in the western part of the division, many of the Gulf-Coast counties from Texas to Alabama, areas of considerable relief in the Appalachians, and the Ozark and Ouachita highlands. Secondary areas of the 0.61–0.99 mile-group include some sandy and poorly drained portions of the Atlantic Coast and the sand plains of central Wisconsin. In addition, the 0.61-mile isarithm happens to approximate the boundary of the cash-grain farming section in central Illinois and western Indiana.

The largest sections in the western division which have great distances between farmhouses are in the more arid and mountainous areas. Large regions which have considerable viticulture, arboriculture, and/or field crop production, such as the Willamette-Puget Sound trough, the Great Valley of California, the Imperial Valley, the Palouse, part of the Snake River valley, and the Salt Lake oasis have rather short distances between farmhouses. Relatively small areas which have intensive agriculture such as the irrigated Salt River valley of Arizona do not appear since the average size of counties in western United States far surpasses that of the eastern division.

Patterns of distribution within a county cannot be shown on this map since this procedure assumes an equal distribution of farmhouses within the basic areal unit.





ILLINOIS

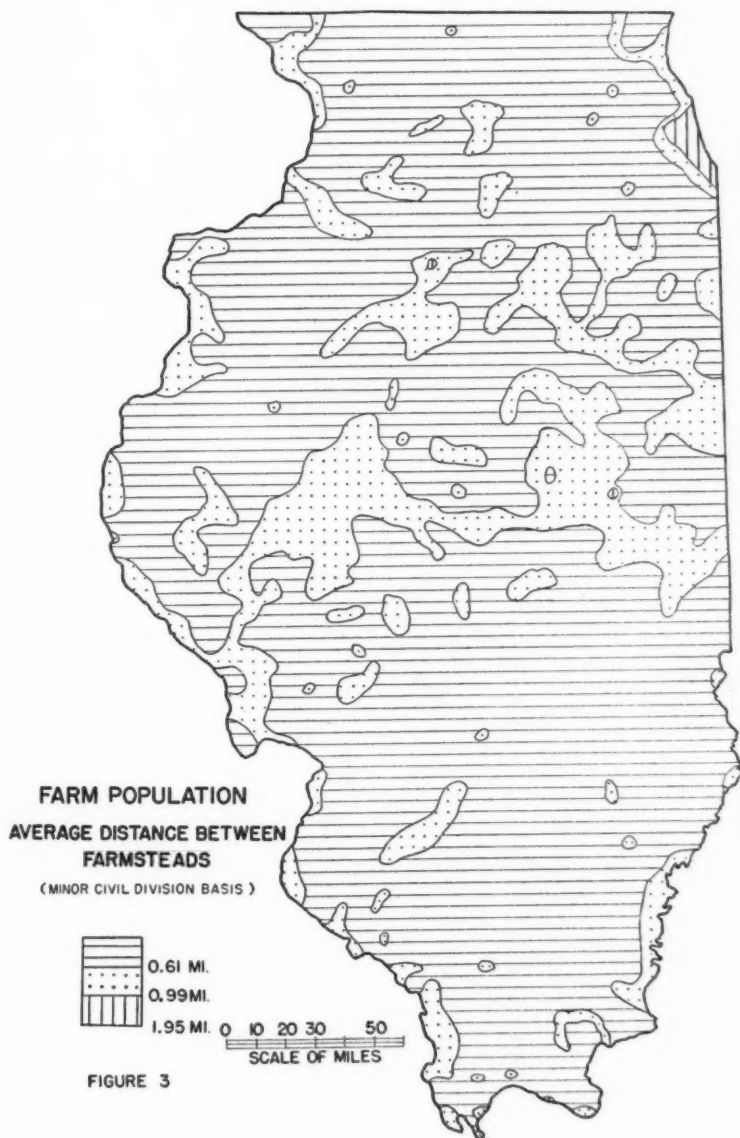
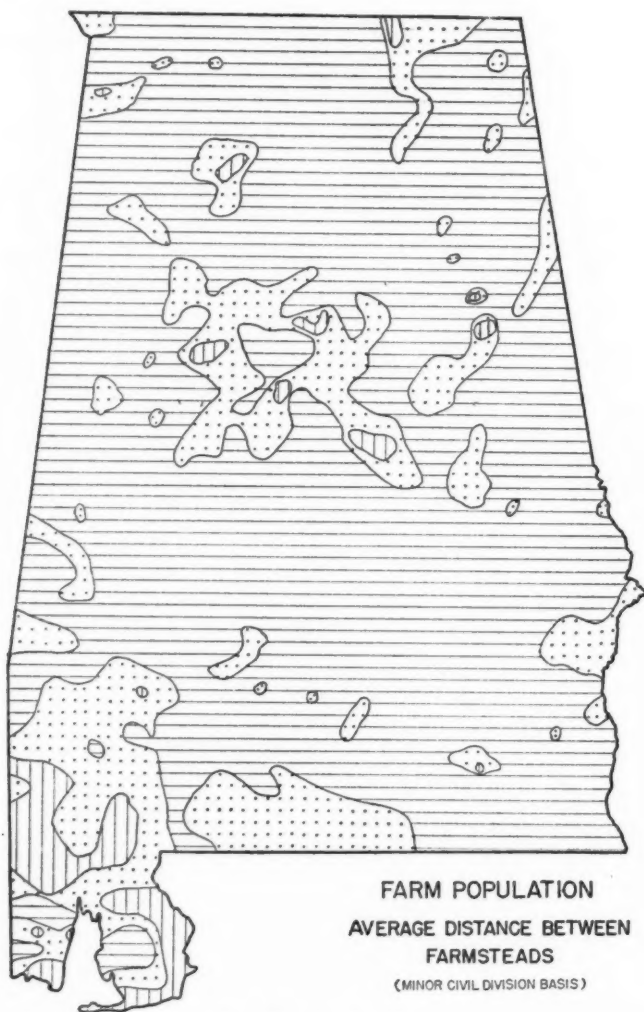


FIGURE 3

ALABAMA



FARM POPULATION
AVERAGE DISTANCE BETWEEN
FARMSTEADS

(MINOR CIVIL DIVISION BASIS)

0 10 20 30 50
SCALE OF MILES

0.61 MI.
0.99 MI.
1.95 MI.

FIGURE 4



